severe cold, attended with a copious deposition of urates; but when the urine became natural, the kystein reappeared. He twice detected cholesterin in kystein.

Kleybolte* has examined the urine in ten cases of pregnancy, and invariably found kystein on the fifth day. The morning secretion was used, and, after being slightly covered to protect it from dust, was allowed to stand, at an ordinary temperature, for ten days. The following appearances were observed in the tenth week of pregnancy: urine peculiarly yellow, with a greenish tint. Second day, mucous sediment; third day, no change; fourth day, turbidity ascending from the bottom; fifth day, white points and leaflets on the surface, turbidity ascending from all parts of the bottom, and the sediment almost gone; sixth day, kystein distinctly observed on the surface, like lumps of fat on the surface of cold broth; seventh day, no change. From the eighth to the tenth day, the kystein disappears, the turbidity again descends, and the sediment noticed on the second day is reproduced. The nine remaining cases are in most respects similar to the above.

A few observations on kystein have been recently published by Audouard,† but contain nothing of importance, except that in six specimens of urine, passed by young women suffering from amenorrhœa,—he found kystein in five.‡—Day's *Report* in *Ranking's Abstract*, vol. ii.

13. *Tubercle.*—Amongst the contributions to chemical pathology, which have been made since our last report, may be mentioned Dr. Wright's essays on the "Pathology of Expectoration." These have been published in the "Medical Times;" they are upwards of thirty in number, and constitute a most admirable addition to our store of knowledge in pathology and practical medicine. Dispersed as they are, over many pages, in different numbers of the periodical referred to, they are necessarily not easy of reference; and we trust, therefore, that Dr. Wright will see the necessity of shortly bringing them out in a separate form, so that they may be more readily within the reach of whosoever may require to consult them.

Dr. Wright's views on the pathology of tubercle are to some extent novel, and we think consistent with the most established facts of physiology, pathology, and chemistry. "In prosecuting this subject," he observes, "I find it most convenient to treat of tubercle according to what may be termed the natural history of its formation. This embraces two particular and definite stages, viz., its primitive, or developmental stage, and its matured, or complete stage; to which, however, may be added a third, not connected with the formative process of tubercle, viz., its softened or decomposing stage. By the term primitive stage, I mean that which is antecedent to the conversion of any, or all, of the tubercle into a yellowish, cheesy-looking, friable mass; the matured stage, which I believe to be the result, for the most part, of an imperfect and depraved organic action in the tubercular body itself, is indicated by the total conversion of this body into the mass whose appearance I have just described; the softened stage is consequent upon a play of chemical affinities amongst the ultimate constituents of the tubercular matter, and represents various degrees of structural disintegration, fluidity, and rottenness."§

"Tubercular matter," he says, "may be formed either in the blood-vessels, or externally to them. But wherever tubercle is produced, the blood itself is essentially the source of it. In those cases, numerous enough, in which tubercle is discharged abundantly, and in a state of complete maturation, from the mucous membrane of the trachea, or bronchi, or bowels, without any lesion of these parts, such matter must have been formed and matured in the circulating system, whence it was eliminated as a foreign body by the most eligible outlet.‖

"If we examine with a good microscope slices of the less diseased portions of the lung of a person who has died of phthisis, we generally recognize a great

* Casper's Wochenschrift, April 26, 1845.

† Journal de Chimie Méd., May, 1845.

‡ Many other communications have recently been published on this subject, which I do not deem necessary to notice, as they are, for the most part, simply confirmatory of the above observations.

§ Med. Times, vol. xi., p. 77. ‖ Loc. cit.

variety of elemental tubercular matter. The following are the chief of its appearances. Granules (resembling in aspect those of germinal cells and of pus-globules), varying from 1-800th to 1-1600th of a line in diameter; aggregated granules, easily detachable from each other, forming an opaque mulberry-shaped mass of variable size; cells, or vesicles, from 1-2500th to 1-1160th of an inch in diameter, of different degrees of transparency, density and development, the complete ones consisting of an envelop and a contained albuminous fluid, with or without central or peripheral granules; and flakes or filaments of all shapes, apparently derived from ruptured vesicles. The cells or vesicles are often of larger size than those just mentioned, especially in the lungs, liver, and mesentery of tame rabbits (giving rise to the fanciful notion that they are hydatids), and in the scrofulous peritoneal deposits of pigs; but in the human subject they are rarely found of any magnitude. If the point of a very delicate needle, sufficiently heated, be passed into the interior of one of these transparent vesicular tubercles, it instantly becomes opaque throughout, from a coagulation of its albumen. This change also takes place spontaneously, at indefinite periods, after the development of the vesicular tubercles, commencing either at their circumference or their centre, and is generally the precedent of the phenomena of maturation. This opacity often occurs, and is not succeeded by any further change in the substance of the tubercular matter. Often the vesicular tubercle enlarges, so as to be readily visible by the naked eye, before becoming opaque, and as often this opacity occurs, the tubercle remaining microscopically small. Under other circumstances, the vesicular tubercle will gradually increase in solidity, and finally become firm and hard, whilst retaining, almost unimpaired, its original transparency. In this state it looks like a particle of very delicate horn. Vesicular tubercles are differently shaped; they vary with their locality; some are globular, some disc-like, some oval, and others irregularly angular. Occasionally, when the vesicular tubercle has not proceeded to the stage of maturation, but has had the watery part of its contents absorbed, the envelop shrinks, and consequently may become crenated, wrinkled, ragged, and variously misshapen.

"As the process of tubercular deposition in the lungs is generally, to a certain extent, in conformity with the laws which determine the formation and regeneration of normal tissues, it not uncommonly happens that the tubercle attaches itself closely, and somewhat complicatedly, to the parenchymatous structure, and can only be separated from the latter by force, when it generally brings away with it a quantity of minute fibrous or mucous material, which gives to the circumference of the tubercle, when placed in water, a pilous appearance. This external covering was first described by Rochoux, who, however, erred in considering it an invariable occurrence, and an appendage *peculiar* to tubercle, instead of what it really is, an adventitious and only occasional attachment. Other appearances than those I have described as belonging to tubercle, appertain to its advanced stages, and are generally recognizable by the naked eye." (*Op. cit.*, pp. 377–78.)

Dr. Wright believes, with most other pathologists, that the formation of tubercle is due to an "error of nutrition," of which he thus speaks: "Mr. Addison says that 'tubercles of the lungs consist of matter accumulated by colourless blood-cells.' To this opinion I am not prepared to subscribe. Elementary granules may, by their aggregation and subsequent development, form colourless blood-corpuscles, pus-globules, or vesicular tubercles; but these are not convertible into each other,—they are specific structures, and cannot be transformed into any analogous structure; they can only advance or retrograde. Hence it may happen to the colourless corpuscles to form healthy tissue, whilst pus and tubercle, in every succeeding change, become more blighted and disorganized. A colourless blood-corpuscle can no more form a pus-globule or a vesicular tubercle, than can either of the latter form a blood-corpuscle. These bodies are as distinct in their microscopical appearances as they are in the circumstances of their formation, or in the final purposes which they serve, or effects which they produce, in the animal economy.

"The extreme states of primitive tubercle are granules and vesicles: the former are elemental of the tubercle; the latter are the perfection of its primitive stage. In so far we see a certain correspondence between the generation of tubercle and the production of normal tissue.

"Tubercle commences with an aggregation of granules; their number may be

few or many. These granules, like those which form colourless blood-corpuscles and pus-globules, have a tendency to develop themselves into a higher structure, and to form cells. From some imperfection, however, either in themselves alone, or aided by a morbid action in the parts wherein they are being deposited, they either remain stationary as granules, or proceed only to an imperfect cell, viz., the corpuscle or vesicle already described. In passing to this vesicular state, the granules, if their number were originally few, are appropriated and expended in the developing of the tubercle, which is consequently seen to possess neither central nor peripheral molecules. When the granules aggregate more numerously, some of them are elevated into a vesicle inclosing the remainder, which appears to aid in the further spontaneous actions of the tubercle, viz., those of maturation. Vesicular tubercles which contain no granules, maturate much more slowly than those which are nucleated.

"Primitive tubercle, though incapable of any direct approach to organization, is not, strictly speaking, an inert body; it is semi-organized, and retains some portion of that low vitality with which it was impressed in its rise and progress from a few aggregated granules. In this consists its dangerous and destructive tendency. The elements of tubercle (granules) may remain in the lungs *ad infinitum*, and neither the patients suffer from them nor physical diagnosis be able to detect their presence; and frequently, indeed, the vesicular tubercles will continue stationary for years, and though obstructing respiration in the portion of lung containing them, may not excite in it any inflammatory action, nor themselves undergo any further, change. Too, often, however, these semi-organized bodies, with their low vitality, perpetuate the action to which they were indebted for their origin, and in consequence pass on to an alteration both of structure and composition, and become *matured tubercles*, at which stage all vitality and all organic power leave them. This maturative action is, for the most part, performed by the constituents of the tubercle, *per se*, though it is in some measure, no doubt, dependent upon the connection of the tubercle with a living body. It never takes place in the dead subject, nor if vesicular tubercle be removed from its site, can any artificial process induce in it the action which is essential to maturation. I have subjected this tubercle, both in its solid and fluid state, to every variety of spontaneous and chemical destruction, without having in any one instance observed an approach to that action, or to the result of it, which in the living body is the necessary forerunner of tubercular softening. Primitive tubercular matter, in its solid state, undergoes decomposition out of the body with singular tardiness. Often, indeed, it will scarcely decompose at all. I have specimens by me at this moment, which are perfectly sound and free from change, though they have been kept without any precaution for nearly five months. Even when *in situ*, it is not uncommon to see the pulmonary tissue of a dead subject sinking into putrescence around these tubercles, themselves being unaffected, or only commencing to decay. I have frequently seen the solid varieties of primitive tubercle floating unchanged in the liquid products of decomposition. And when vesicular tubercle *does* decompose, it undergoes no alteration of composition or of appearance beyond that which any simply albuminous matter suffers in the process of decay. But the action of tubercular maturation in the living body is a very different thing. From having been simply and entirely albuminous, the tubercle has become more compound in its nature. It now contains a notable, but a variable proportion of fat; occasionally gelatin; and its albumen, instead of being homogeneous-looking, has acquired an irregularly granular and massy appearance, and sometimes seems to have made an approach even to a fibrous structure. The action necessary to this change has no analogue in any process of decomposition with which we are acquainted. It is (within certain limits) to all intents and purposes an organic action. It is, perhaps, as low a form of organic action as any we are acquainted with, but is plainly an offspring of forces which are beyond those that are merely chemical and physical. (*Op. cit.*, pp. 418–19.)

"The process of tubercular softening, *properly so called*, is simply one of decomposition. It has nothing in common with the development and maturation of tubercle, but is consequent merely upon a chemical change of the elements of matured tubercle." (p. 477.) Upon the subject of the absorption of tubercular matter, Dr. Wright makes certain observations as the result of extensive and carefully con-

ducted experiments. He says, "Tubercular matter in small quantity, in the blood, is productive of no inconvenience or injury so long as it circulates freely; and if its discharge by any mucous membrane, not likely to give it lodgment, be certain, I think it probable that tubercle might be constantly passing through the circulation without occasioning injury. Tubercle, before having commenced to decompose, is as harmless as laudable pus, or any other substance having a similar composition. The only manner in which it could prove detrimental in the blood-vessels, would be by accumulating in some situation where, by not being subsequently thrown off, it would decompose, and so lead to the destruction of the contiguous tissue, or to the contamination of the whole system." (Op. cit., p. 525.) Concerning the chemistry of tubercle, Dr. Wright says, "Its composition is scarcely less variable than are its physical appearances and properties. Like these it differs according to the age, the degree of maturation, and the locality of tubercular matter. Chemists as well as microscopists, have fallen into the error of taking a single specimen of tubercle in a particular state ('crude'), and from its analysis, of inferring the composition of tubercle in its entire acceptation. No error of inquiry or induction can be greater than this.

"Primitive tubercular matter, in its fluid transparent state, is purely albuminous, and affords neither reactions nor analytical results at variance with those of any simple albuminous solution. It appears to be neutral to test-paper, but galvanism or incineration furnishes evidence of the presence of soda. Sulphur is also a constituent, but in still smaller proportion.

"Solid primitive tubercle, transparent or opaque, usually answers to analysis like coagulated albumen. Often, however, owing to the length of time it may have been deposited, or the situation in which it may have been placed, it will be found to have acquired a greater or less proportion of earthy or saline matter, or both. The change appears to be effected by a process of endosmose and exosmose.

"Matured tubercle, also, according to the extent of its maturation, will vary in chemical composition. In proportion as it has advanced to maturity, will its fatty matter, or gelatin, or fibrin, or all of these, be abundant. The ratio of its earthy and saline constituents is also liable to much variation.

"In the progress of decomposition (softening) the constituents of tubercle are changed both in number and kind. The gelatin is usually the first to disappear; then the traces of fibrinous structure become indistinct or are lost; the cells are obliterated; the fatty matter is discoloured and fetid; ammonia, or its hydrosulphate, is disengaged, and the mass sinks into liquidity and rottenness."

Dr. Wright says, that tubercle is apt to derive some physical or chemical peculiarity according to its site, as, for instance, in the liver, brain, mesentery, kidney and near the rectum. (Op. cit., p. 525.) He found the composition of matured (cheesy) tubercle to vary considerably. The two following analyses he gives as the mean result of his investigations:

Fatty matter, with oil globules	15·9
Gelatin	6·4
Phosphates, Sulphates, Muriates of Lime, Soda	11·2
Carbonate of lime, a trace.	
Oxide of iron, a trace.	
Albuminous matter with fibrin	65·2
	98·7
Fatty matter, with oil-globules	7·4
Gelatin	11·8
Phosphates, Sulphates, Muriates of Lime, Soda	2·5
Albuminous matter	76·9
	98·6

—*Ibid.*